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Abstract

Since 1992, Women, Infants, and Children at the Lincoln Lancaster County Health Department has provided supplemental food benefits, nutrition information, breastfeeding support, immunization referrals, and dental services to support low-income families and their children. However, statewide, the retention rate has been dropping since 2009, and if this continues, it can result in adverse health outcomes. As part of the Service Learning activities, this study aims to evaluate current services on clients' experiences and improve their satisfaction by conducting the WIC participant-centered services survey. This cost-effective intervention program has been working successfully, however it does not provide the information of environmental health.

To understand WIC enrolled families' home environment, as part of the Capstone Experience we conducted the indoor air quality survey to investigate existing indoor air contaminants and related health problems. This survey was a questionnaire designed to collect information of sources of air pollution in homes (cleaning practices, natural and forced ventilation, lead, mold, tobacco smoke, etc.) and resident's respiratory symptoms. The data was collected by face-to-face interviews at the two WIC clinics, LLCHD and satellite office, from 50 individuals who have lived in their current residence more than six months. The results were used to identify present residential air contaminants that can cause respiratory symptoms. Health effects caused by indoor air pollution is preventable by good maintenance and housekeeping practices.

The goal of the project is to increase the mother's knowledge about indoor air quality in low-income communities and support them to reduce contaminants for better health outcomes. Ultimately, the information collected by surveys can be used to plan a support program that increases mother's awareness of air pollutants and prevention.

Chapter 1: literature review

Women and children in low-income households have many challenges in nutrition and health. Women, Infants, and Children (WIC) is one of the programs to support and improve their health-related quality of life. WIC is a preventative special supplemental nutrition program to support low and moderate income pregnant and breastfeeding women, non-breastfeeding postpartum women, and infants or children up to age five.

WIC started as a pilot program in 1972 to fight rising hunger and nutrient deficiency in low-income pregnant women and their children. According to the Food and Nutrition Service, since the first WIC site opened in Kentucky in 1974, they are currently operating in "50 state health departments and 34 Indian Tribal Organizations, the District of Columbia, and five territories (Northern Mariana, American Samoa, Guam, Puerto Rico, and the Virgin Islands)"[1]. The WIC program (2017) reported that approximately 7.2 million participants enrolled in the program, with 23.8% being women, 51.4% being children, and 24.7 % being infants. Overall, approximately 53% of eligible infants born in the United States receive the benefits provided from WIC[1]. WIC is a domestic discretionary program that set the funding through the annual congressional allocations. Food and Nutrition Service (FNS), part of the United States Department of Agriculture, provides the funding, policy guidelines, and regulations for WIC program[2].

Chock, Hayes, and Tomiyasu (2014) described how WIC has operated, what services they provided, and what health related improvement they achieved in the last 40 years[3]. WIC provides supplemental foods (checks), nutrition education, breastfeeding promotion and/or support, and referral to social and health services. WIC recipients can use the checks at authorized local grocery stores to purchase fruits, vegetables, low-fat dairy items, whole grains,

and formula, which are included in the list of foods in the revised WIC food packages. In 2009, the food packages were updated to improve availability and divergence of health foods at authorized stores. To enhance participants' satisfaction of the services, WIC has been working to have better services. Since WIC started their program, they have given a great health impact to the target populations: fewer premature births and infant deaths, improved breastfeeding outcomes, higher childhood immunization rates, and enhanced nutrition status and oral health. The most remarkable outcomes are reduced infant mortality rate and low birth weight, especially when prenatal women participated in the program. Devaney (1992) in the U.S. Department of Agriculture observed birth outcomes from prenatal WIC participants in five states in the United States and found that the incidence of very low birth weights alleviated[4]. Additionally, they estimated that the improvement in prenatal care by registering for WIC programs would result in a significant healthcare savings (2.3~4.5 million) for mothers and newborns from birth to 60 days after. Devaney (1993) continued a 1992 study and determined that there was a significant decrease the incidence of infant and neonatal mortality in prenatal WIC participants[5]. Thanks to the WIC prenatal care, health for pregnant women and children have been improving along with great medical cost savings.

One of the WIC services are referring and offering dental services. Dental care is a considerable health problem for children in low-income families. Lee, Rozier, Norton, Kotch, and Vann (2004) examined the effects of WIC program on dental services and found that children that participated in WIC are more disposed to have dental care including preventative and restorative services than WIC non-participants[6]. This successful intervention program has improved many health issues for women, infants, and children as described. However, WIC does not provide

information and services for air pollutants in homes. These pollutants existing in homes can harm residents, particularly pregnant women, infants, and children.

Indoor air can be contaminated with Volatile Organic Compounds (VOC), formaldehyde, pesticides, lead, carbon monoxide, sulfur dioxide, environmental tobacco smoke, biological contaminants, asbestos, and radon. The source of these air contaminants that we can find in homes are perfumes, hairsprays, cleaning solvents, pesticides, furniture, lead-based paint, fireplace, wood stove, tobacco products, animals, house dust, asbestos, radon, etc [7].
Ghosh, Wilhelm, and Ritz (2009) examined the association between IAQ and adverse birth outcomes; preterm birth (adjusted odds ratio (OR) = 1.27; 95% confidence interval (CI) = 0.95, 1.70) and low birth weight (LBW) (adjusted OR = 1.36; 95% CI = 0.85, 2.18) in Los Angeles County, California[8]. To investigate indoor air pollutants and pregnancy outcomes, they utilized survey collection data and birth certificates. They observed increased odds of term LBW and preterm birth when pregnant women were exposed to secondhand smoke (SHS) with less frequent window ventilation (less than half the day) compared to unexposed women for full-term pregnancy. Besides the SHS, adverse birth outcomes were increased when women were exposed to personal/household products including nail polish, hairspray, and insect spray in homes with low or no window ventilation. But the risk was not increased when windows were opened frequently even if women were exposed to SHS. They concluded that a proper natural ventilation system may alleviate the adverse pregnancy outcomes that come from indoor air pollution. Without the conclusion of Ghosh et al.'s aid of proper ventilation, poor IAQ would give a direct impact to a vulnerable group including pregnant women and children. Moreover, the poor IAQ affects not only birth outcomes but also respiratory symptoms. Thorne (2015) et al. examined the impacts of endotoxin exposure on asthma outcomes [9]. For this study, data in the National

Health and Nutrition Examination Survey (NHANES) was analyzed and for endotoxin analysis, dust samples were collected from beds and bedroom floors. They found that elevated high levels of endotoxin is associated with increased risks of wheezing and the allergy symptoms were worsened in low income households. Besides poverty, there were more predictors of higher endotoxin exposures including older homes (built before 1978), younger age, pets (dog and cat), cockroaches, carpeted floors, and smokers in the home. Additionally, at low levels of specific IgE against dog, mouse, and rat, endotoxin was strongly associated with asthma but not at high levels of IgE against mouse and rat.

As described, various indoor air pollutants and allergen factors exist in homes, especially in low-income households. When socioeconomic disparities exist, residents have a higher chance of having poor IAQ. Adamkiewicz et al. (2011) reviewed empirical data of IAQ affected by socioeconomic disparities and additional data from the 1999 American Housing Survey to determine the factors contributing to indoor environmental disparities[10]. Households of low socioeconomic status are more likely to present multiple pollutants, such as lead, VOCs from SHS, combustion byproducts, fine particulate matter ($PM_{2.5}$), etc. Interestingly, they described that 90% of high concentration of $PM_{2.5}$ exposure was due to indoor sources while the low $PM_{2.5}$ exposure level was most likely from outdoor sources. NO_2 showed the same results as described for $PM_{2.5}$. This study showed that there is higher chance of exposure to fine particles in homes. Next, we wanted to identify the major sources of fine particulate matter.

Klepeis et al. (2017) monitored fine particle counts in low-income households with children and at least one cigarette smoker in San Diego, California [11]. In parallel, they also collected information of contaminant sources by conducting survey. Some of their study participants were WIC registered families. They found that high weekly mean particle counts were associated with

cigarette or marijuana smoking, frying food, candle and incense usage, and house cleaning activities. Ventilation is one of the prevention to mitigate the level of air contaminants, but they couldn't find significant association between ventilation activities and mean fine particle counts. As discussed above, low-income families are a high-risk group for indoor air pollution, which can result in many health problems. To clarify the sources of air contamination, it is important to monitor the contamination level and survey the house characteristics and existing contaminant sources in parallel.

WIC families are low-income households, living with vulnerable populations of pregnant women, infants, and children, but there is no study that investigates their indoor air pollutants and health problems. Thus, for further study, it is important to understand WIC families' environment and work for improved quality to promote healthy lives.

Chapter 2: Capstone Experience

Survey of indoor air quality in residences of WIC participants in Lincoln, Nebraska

Abstract

This study identified current and potential risk factors that could be associated with poor indoor air quality in the residences of Women, Infants, and Children (WIC) program enrolled families. The sources of indoor air contaminants and health problems were collected by in-person interviews with 50 study participants at two WIC locations.

Using the survey data, we found potential air contaminant sources in WIC registered households: lead-based paint, HVAC air filter changing practice, absence/lack of ventilation system and natural ventilation, water leakage, pet dander, mold, and smoking. The indoor air pollution sources existing in homes may cause residents' respiratory diseases; four households whose allergies/asthma symptoms got worse when they stayed inside of house, were reported to have at least two of the common air contaminants in homes. According to the data, we also found that families living with a smoker had a higher incident rate of asthma than families living with a non-smoker despite smoking outside of the house.

Health effects caused by indoor air pollution is preventable through good maintenance and housekeeping practices. Further, the information collected by this survey can be used to plan for a supportive program to increase WIC-registered mothers' awareness of air pollutants and their prevention.

1. Introduction

Poor indoor air quality (IAQ) is one of the top environmental health problems in the United States. The Environmental Protection Agency (EPA) stated that the level of some indoor air pollutants such as volatile organic compounds (VOCs) was higher than the levels of outdoor pollutants [12]. Americans spend approximately 68.7% of their time inside of homes [13]. As a consequence of the energy crisis in the 1970s, buildings are built airtight to save on energy costs. Pollutants inside these buildings could be potentially trapped due to insufficient ventilation [14]. Air pollutants in homes include chemical hazards (formaldehyde, lead, cigarette smoke, radon, and pesticide), physical hazards (noise, electromagnetic radiation), and biological hazards (mold, pet dander, viruses, and bacteria). When the concentration of these pollutants is high, it can cause adverse health problems. Health hazards associated with poor air quality include acute hazards (headaches, nausea, dizziness, breathlessness, and fatigue nasal, eye, or skin irritation, sore throat, and cough) and chronic hazards (asthma, cancer, allergic rhinitis, heart/kidneys/central nervous system damage) [14].

Children are more susceptible to the adverse health effects than adults because their immune systems, brains, and organs are still not fully developed. For their size, they breathe twice as much air through their airways than adults and they are also more active than adults [15]. At poor air conditions, they can inhale more contaminated air and this can result in adverse health outcomes. Previous studies observed respiratory, allergic, or immune effects in infants and children due to high concentration of VOCs, formaldehyde, or phthalates from cleaning supplies, new paints, new carpets, new furniture, renovations, or plastic containing materials [16, 17].

According to previous studies, people of lower socioeconomic status are much more affected because of the clustering problems of inadequate ventilation systems, combustion byproducts, smoker(s) in the house, housing maintenance, and proximity to industry [18-20]. In this study, we focused on WIC families because they are low-income families that reported higher chances of exposure to contaminant sources and live with children.
We looked at families who enrolled in the Lincoln Lancaster County Health Department (LLCHD) WIC program. Our target population is living with at least one child and it is essential to examine possible air contaminants present in their homes. By conducting indoor air quality surveys by face-to-face interviews, we found the existing and potential air contaminants in their homes and observed an association between pollution sources and respiratory diseases.

2. Methods

2.1. Study Design

In this cross-sectional study, we administered a questionnaire to 50 WIC participants receiving services at two WIC locations in Lincoln, Nebraska; 25 participants from the office at the Lincoln Lancaster County Health Department (LLCHD) and the remaining 25 from the WIC satellite office in North Lincoln. The sample size of study participants was calculated based on the Central Limit Theorem (CLT) probability theory.

We read each question to increase survey participants' understanding of the questionnaire. All the collected information was entered into Microsoft Excel for a simple analysis such as frequency percentage.

2.2.Eligibility criteria

Study participants were mothers who were at least 18 years of age, enrolled in the LLCHD WIC program, and have been living at their current residence for at least 6 months.

2.3. Questionnaire

We developed a questionnaire to understand potential air pollutant sources in homes, and potential adverse health effects experienced by the participants and their families. The questionnaire is provided in Appendix I.

Briefly, we collected information regarding improper ventilation system in bathrooms and kitchens, general cleaning practices, housing information, smoking, pets, natural ventilation through windows or doors, water or mold problem, and frequency of changing filters. In addition, we collected information related to the study participant's respiratory symptoms and the severity of the symptoms at home. The collected data was used to investigate the relationship between air contaminants and health problems.

The Institutional Review Board of the University of Nebraska Medical Center classified it as an exempt protocol. However, in order to provide privacy guidelines from the Health Insurance Portability and Accountability Act (HIPAA), the consent form was prepared as shown in Appendix I. Prior to the initiation of the interview, all interviewees were given adequate information about the study and written informed consent was obtained from them. Study participation in this research was completely voluntary and participant's identifying information was not asked or collected.

3. Results

3.1. Demographic characteristics of study participants

The study participants were women who were enrolled in the WIC program; this means that their household income did not exceed 185 percent of the U.S Poverty Income Guidelines. They were native and non-native English speakers. Among them, 50% (25/50) completed high/secondary school, 42% (21/50) owned associate or Bachelor's degree, 4% (2/50) had graduate degree, and 4% (2/50%) reported none of these degrees applied to them.

3.2.Housing type and age

As summarized in Table 1, 72% of study participants who visited the south office live in an apartment while only 25% of participants who visited the north office live in an apartment. Among the 50 study participants, 9 households (5 in the north and 4 in the south WIC offices) have lived in houses built 1978 or older. 5 of these households (4 in the north and 1 in the south WIC offices) reported having a problem of paint chipping and peeling.

3.3. Sources of indoor air pollution

A majority of the participants reported having a functional ventilation system in the bathroom and kitchen. However, 4% (2/50) did not have ventilation at home and 6% (3/50) had only one fan, either in the bathroom or kitchen area. When asked about household cleaning practices, most participants reported that they sweep and mop their area daily or weekly, but only 18% (9/50) reported that they dust monthly. In contrast to their cleaning practices, 40% of study participants answered that they opened a door or a window daily for fresh air. The rest of participants' houses were naturally ventilated periodically due to an impaired window, hot or cold weather, and seasonal allergy symptoms. Common reasons cited for not opening the windows were due to allergies and/or asthma (11/50 participants).

Interestingly, one participant reported that the symptoms get worse inside the home, but they still did not prefer to open windows.

We also collected information about how often the air filter was changed in a home. In this survey, 44-60% of participants changed the air filter every 1-3 months, 12-28% changed every 3-6 months, 12% changed every 6-17 months, and 16% of the participants did not know when the filters were changed (Table1). Among the 16% (8/50) who did not know about the filter change, 2 were living in an apartment, 4 in a house, and 2 in a trailer home. Since smoking is well known sources of air pollution, information about smoking was collected as well. Among all of our study participants, those that reported that they were or lived with a smoker claimed that they didn't smoke inside the house. However, 36% (18/50) of participants reported having at least one member who smoked outside of their house. Among these households, 66% (12/18) of participants reported having allergies, asthma, or both symptoms. The prevalence of asthma and/or allergies was higher than the prevalence 47% (15/32) in non-smoking families (Table2).

Additionally, we found that participants 26% (13/50) reported poor indoor air quality and increased their outdoor activities due to the air quality issues at home. The questionnaire did not collect data on how the participants tried to adjust poor air quality at home.

3.4. Respiratory symptoms and potential triggers

In this study, 27 participants reported that someone in their household was suffering from respiratory symptoms as described in Tables 1 and 2. Interestingly, four of them reported that their symptoms seem worse when they stay at home. The possible allergies and/or asthma triggers found in their homes through the survey were described in Table 3. According to the

survey data, they reported having at least two of the listed risk factors of air pollution: lead based paint chipping/peeling, absence of ventilation system, delayed changing air filter, smoking, and limited living space. It seems that they did not have proper information and awareness of the importance of changing the HVAC filter.

Even though 23 participants had not been diagnosed with allergies or asthma, we also observed potential air contaminant sources. Among them, 6 families lived with a smoker and 1 family lived in the house built before 1978 that reportedly had chipping paint. 2 families had water problems and 2 other families experienced cough and irritation inside their homes, even though they believed that was due to seasonal allergies, as it did not persist for a long period.

4. Discussion

This study explores the sources of residential air pollution in WIC enrolled low-income families who are living with at least one children or pregnant women. Air pollutants are well defined and investigate the risks especially in low-income families or people living with children or smokers. When biological, chemical, or physical pollutants are present, many studies observed poor indoor air quality and adverse health outcomes. A previous study recruited WIC participants as part of their study population [21], but they did not investigate this group exclusively. WIC participants are low-income families who are eligible to receive nutritious benefits through the WIC and visit clinics regularly. We can monitor this population for IAQ in their environment regularly and implement a prevention program. For this study, we administered IAQ surveys at the two WIC clinics in Lincoln, Nebraska, and observed potential contaminants sources in their homes. We observed several sources of

air pollution including lead-based paint chipping/ peeling, uninformed or delayed HVAC filter change, lack of ventilation, low frequency of opening windows/door, occupant density, and smoking. These contamination sources are highly associated with acute and chronic health problems especially in vulnerable groups.

Houses built before 1978 would likely have a lead-based paint related problems. Lead contaminated dust from chipping or peeling lead-based paint can be found in the air or floor/carpet. Lead poisoning can affect the brain and central nerve system in children [22]. Additionally, an earlier study showed that it also could cause respiratory disease such as chest tightness, cough, and sputum [23]. Since there is no known safe level of lead in children [24], it is important to educate the target population who are living with children.

According to a previous study, less frequent or no windows openings increased the risks of adverse birth outcomes from indoor air pollution [25]. To remove or dilute trapped contaminant sources in homes, it is important to change air filters and open windows or doors for a natural ventilation regularly. HVAC air filter has an important role to trap common indoor contaminants including dust, animal dander, pollen, mold, etc. and work for passing air readily, so it needs to be changed regularly.

Smoking has been linked to children's health problems including asthma or wheezing [26, 27]. Currently, this study showed when families lived in a home with smoker, the incident rate of asthma was higher than families living with non-smoker. According to the 2006 US

Surgeon General report, there is no safe level of SHS[28]. Additionally, when children were exposed to SHS, the incidence of respiratory infections and asthma increased[29]. Even when smoker smoked outside of the house, the smoke and harmful substances of the cigarette settled on their skin, hair, and clothing and when they came inside of the house, the other member of family can be exposed to the cigarette, which triggers asthma, especially in children[30, 31]. When people have respiratory disease, second hand/ third hand smoke exposure could make their symptoms worse [28]. To prevent many respiratory diseases caused by residents' indoor air pollution due to the secondhand smoke, Smoking Quit program and delivering empirical information/study should be followed.

Importantly, we observed that there were households whose allergies/asthma symptoms got worse when they stayed inside of the house and better when they were outside of the house. However, it is not clear what was the main reason that made the symptoms get worse and whether it was due to single or multiple sources. To identify air pollutants that worsened respiratory diseases, further in-depth research is necessary with sample collection(s) and measurement(s).

The strength of this study is that it is the first study to observe the air contaminant sources specifically in WIC enrolled families. This population is important to look at because this is a service only for families with children and pregnant women, who are vulnerable to air contaminants.

One limitation of this study is that it had a small sample size with only 50 participants. It did not observe who had allergies and/or asthma among their house members, so we did not

know how many young children were suffering from these respiratory diseases in their families. For future research, it is important to investigate the age of those who have respiratory symptoms, especially children.

5. Conclusions

Many households may not be aware of existing and potential sources of air contamination in homes and may not have proper information of air quality improvement. The information obtained from this study would be used to understand and suggest prevention practices that improved the current indoor air quality for WIC registered low-income families. For their health and perception about indoor air quality, we are considering developing programs or guidelines that deliver appropriate information to our target audiences.

Tables

Table1. Air quality results obtained from WIC clinics in Lincoln, Nebraska

General Description	Characteristic	WIC Clinics	
		North (n=25)	South (n=25)
Housing	Apartment	7 (28%)	18 (72%)
	House built before 1978 with peeling paint	4 (16%)	1 (4%)
	House built before 1978, but no paint peeling	1 (4%)	3 (12%)
	House built after 1978	7 (28%)	2 (8%)
	Unknown house year, but no paint peeling	3 (12%)	1 (4%)
	Trailer	3 (12%)	0 (0%)
Changing Filter	3 months or less	15 (60%)	11 (44%)
	Between 3 and 6 months	3 (12%)	7 (28%)
	More than 6 months	3 (12%)	3 (12%)
	Don't know	4 (16%)	4 (16%)
Education	High School	11 (44%)	14 (56%)
	Associate/Bachelor's degree	11 (44%)	10 (40%)
	Graduate degree	1 (4%)	1 (4%)
	None	2 (8%)	0 (0%)
Water problem	Yes	2 (8%)	2 (8%)
	No	23 (92%)	23 (92%)
Mold	Yes	0 (0%)	1 (4%)
	No	25 (100%)	24 (96%)
Fans in bathroom and kitchen	Yes	24 (96%)	21 (84%)
	No	0 (0%)	2 (8%)
	Either bathroom or kitchen	1 (4%)	2 (8%)
Pet	Yes, sleep in their own bed	5 (20%)	7 (28%)
	Yes, don't have their own bed	3 (12%)	0 (0%)
	No	17 (68%)	18 (72%)
Cleaning Practice			
Dust	Daily	8 (32%)	8 (32%)
	Weekly	13 (52%)	12 (48%)
	Monthly	4 (16%)	5 (20%)
Sweep	Daily	21 (84%)	19 (76%)
	Weekly	3 (12%)	6 (24%)
	Monthly	1 (4%)	0
Mop	Daily	10 (40%)	9 (36%)
	Weekly	13 (52%)	11 (44%)

	Monthly	2 (8%)	5 (20%)
Natural ventilation through window	Daily	10 (40%)	10 (40%)
	Weekly	9 (36%)	4 (16%)
	Monthly	3 (12%)	3 (12%)
	Rarely	3 (12%)	8 (32%)
Smoking	Yes, but not inside of house	8 (32%)	10 (40%)
	No	17 (68%)	15 (60%)
Respiratory Symptoms	Allergy	9 (36%)	7 (28%)
	Asthma	1 (4%)	1 (4%)
	Allergy and Asthma	3 (12%)	5 (20%)
	Allergy and Acute Bronchitis	1 (4%)	0 (0%)
	No issues	11 (44%)	12 (48%)
Symptoms better or worse inside of house	Better	9 (36%)	10 (40%)
	Worse	2 (8%)	2 (8%)
	Not clear or not affected	3 (12%)	1 (4%)
Increased outdoor activity due to poor indoor air quality	Yes	5 (20%)	8 (32%)
	No	20 (80%)	17 (68%)

Table2. Allergy and Asthma in households with smokers and non-smokers

Family member	Allergy	Asthma	Allergy & asthma	Allergy & acute bronchitis	Total
Smoker (18/50)	5 (5/18, 28%)	2 (2/18, 11%)	5 (5/18, 28%)	0	12
Non-smoker (32/50)	11 (11/32, 34%)	0	3 (3/32, 9%)	1 (1/32, 3%)	15

Table3. Households with possible indoor allergy triggers

ID	Zip code	Housing	# bedroom(s)	# resident(s)	Changing air filter	Ventilation system	Natural ventilation	Smoking
S5	68510	House built before 1978 and have paint chipping issues	2	4	6 months	Available	Rarely	No
S7	68508	Apartment	0	3	Don't know	Not available	Daily	Yes
N1	68503	House built before 1978 and have paint chipping issues	3	4	1 year	Available	Daily	No
N6	68521	House built after 1978	3	4	Don't know	Available	Monthly	No

*They did not live with pet and overall have a good cleaning practices.

Chapter 3: Service learning and competencies

Women, Infants, and children (WIC) is federal funded program to support low-income pregnant and postpartum women, infants, and children under five years old by providing supplementary food, formula, breastfeeding and nutrition education, referral, and dental fluoride application. Since 1992, WIC in the LLCHD have been providing nutritious foods, nutrition and health information, breastfeeding support, immunization referrals, and dental services (fluoride varnish and examine caries). Currently they have approximately 4,000 enrolled mother, infants, and children per month who visit WIC clinics to receive benefits described above.

However, according to the FY 2016 annual report from the Food Assistance Landscape[32], participation numbers have decreased statewide by approximately 16 percent since in 2010. According to WIC-LLCHD, as with other states, the returning number of enrolled participants has been dropping. WIC-LLCHD has provided health benefits to approximately 4,000 participants per month. In February 2017, only 82.5% (3,300 families) of enrolled participants had benefits and the remaining 17.5% (700 families) of them did not return to claim benefits, which include checks to buy WIC-approved food. This reduction can be caused when the target population prefers Supplemental Nutrition Assistance Program (SNAP) rather than WIC program, due to easier application and food access using Electronic Benefit Transfer (EBT) card and higher benefits[33]. Many WIC programs in the United States are still providing checks to shop for groceries while SNAP provides EBT cards. Moreover, participants are required to visit WIC clinics for a face-to-face nutrition counseling to receive the benefits. This face-to-face counseling discusses the importance of breastfeeding, nutrition, and health concerns. However, if the participant is busy at work or there are any difficulties getting to the clinic due to their personal issues, they will miss out on the benefits.

So, to evaluate and improve the current WIC services, I worked with WIC-LLCHD for a preparation of survey administration, data collection, entry, analysis, and final report. The questionnaire, as shown in Appendix II, was established by applying WIC Participant-Centered Services Model [34] and collected survey data was entered into Survey Monkey for further analysis. Through this survey, WIC-LLCHD is aiming to figure out what are the potential problems or barriers to retention and work to improve the WIC program.

Service Learning/Capstone Experience Reflection

The service learning activities were performed at the Lincoln Lancaster Health Department's WIC clinics at two locations: a) the health department location (3140 N Street) and; b) satellite clinic (2662 Cornhusker HWY Suite 7).

While I observed the WIC appointments, I have learned how WIC staffs manage scheduling, confirm visits, counsel participant's nutrition and health concerns, provide the checks for supplemental foods and formula, offer and introduce dental services at the health department and refer to health providers if it is necessary. LLCHD WIC is collaborating with other programs at the health department and partnering with local stores such as Walmart, which recently hosted diaper drive for WIC to help local families [35]. They are also partnering with other organizations for a healthy community. I had chances to attend the Nebraska Breastfeeding Coalition and Lincoln Medical Education meetings and it was great opportunities to learn how LLCHD WIC has been sharing their experiences and supporting health related community programs.

These activities helped me to understand the organization and target population prior to conducting two surveys for the service learning and capstone experience (SL/CE). First, as part of CE activities, the indoor air quality survey was conducted through face-to-face interview

(N=50) at the Lincoln Lancaster Health Department's WIC clinics at two locations: the health department location (3140 N Street) and satellite clinic (2662 Cornhusker HWY Suite 7). For the indoor air quality surveys, a consent form was prepared to provide enough information of study and to ensure that study population agreed to participate the survey. For the WIC participant-centered services survey as part of SL activities, the sample questionnaire was provided from the WIC in Omaha, Nebraska. The questionnaire was reviewed and modified slightly for a better formatting to be analysis into Survey Monkey (https://www.surveymonkey.com/). Health Promotion, Data and Evaluation Division at the LLCHD gave advice for administering surveys effectively. LLCHD has a good cooperation system so that each program and department can be supported by other programs for a better outcome. After the update of the questionnaire, data was collected at the two WIC clinics in Lincoln as described above and then the survey data was entered into Survey Monkey for further analysis.

The most challenge of my SL/CE was recruiting the study population. LLCHD WIC has a large Spanish and Arabic speaking populations, but questionnaire was only available in English. Additionally, there was a restriction of study population for the CE that only residents who have lived in their current place more than six months were eligible to participate the survey. For further study, LLCHD WIC is planning to prepare questionnaire in multiple languages to reduce language barriers. Taken together, these activities and experiences allowed an in-depth understanding of the LLCHD WIC program from a clinic and client perspective.

During the interviews for the CE, I tried to deliver the information about possible air contaminants in homes rather than just conduct the surveys. Respiratory diseases caused by residential air pollution are preventable, so being aware of air pollution sources would have a great impact to our health. The introduction of indoor air quality surveys in the community was

the first step to determine air pollutants in low-income homes. I believe it increased the study participants' awareness of air pollution and related health risks.

Through the SL/CE, I could understand about the organization and clients, observe many activities at the health department, and attain practical skills and methods used in public health. I am confident that all these practices would be of great benefit when I work in the field of public health.

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Appendix I

University of Nebraska Medical Center
College of Public Health
Environmental and Occupational Health

CONSENT FORM

Name of Project: Assessment of indoor air quality in residences of WIC participants

We would like to tell you about a research study we are doing and ask for your participation. We are doing research of WIC participant's residential indoor air quality (IAQ). In this study, we want to find out common or potential indoor air contaminants at your home environment and any respiratory symptoms possibly caused by air contaminants at your home. Your participation in this research study is completely voluntary.

If you agree to take part in this study, you will be asked to complete the residential IAQ survey. The whole process should take 10-15 minutes of your time. This study is completely anonymous. We will not ask for your name or any identifying information. And the collected data will be accessed only by our research team members.

During this *face-to-face* survey, if you require further clarification, you may ask me at any time. Also you can skip any questions or may free to stop participation at any time without penalty.

We do not anticipate any risks from participating in this research. And there are no direct benefits to you as study participant. However, we hope to learn about your environment through this IAQ survey and work to improve residential indoor air quality in the future.

Any questions you may have about this study may be directed to Eun Hee Kwon, by email at eunhee.kwon@unmc.edu or Dr. Chandran Achutan, at cachutan@unmc.edu. Thank you for your participation.

If you agree to participate in this research study, please sign below.

Signature of participant _____

Date _____

1. What is your home zip code? _____

2. What is your type of housing?
   - Apartment
   - Townhome/ House: was your house built before 1978?
   - How many bedrooms does your house/apartment have?
   - Others_____

3. How long have you lived in this area?_____

4. How often you change air filter?

5. How many people currently live in your home?

Age (years)	Number of people
0- <6	
6-<19	
19-<65	
65+	

6. What is your household's highest level of education?
   - ○ None
   - ○ High/Secondary School
   - ○ Associate degree/Bachelor's degree
   - □ Graduate degree

7. Have you had following water problems in your household?

   □ Leaky ceiling □ Leaky basement □ Leaky pipes

8. Does your home have proper ventilation? □ Yes □ No

9. Do you have any pets living indoors? ○ YES ○ NO

If **YES**, what kind?_____

10. How often do you dust? O Daily O Weekly O Monthly O Don't want to answer

11. How often do you sweep? O Daily O Weekly O Monthly O Don't want to answer

12. How often do you mop? O Daily O Weekly O Monthly O Don't want to answer

13. How often do you open windows or doors for natural ventilation?

    O Daily O Weekly O Monthly O Don't want to answer

14. Have you or anyone in your household experienced any of the following symptoms inside of your home or while being outside in your neighborhood? Please check **YES** if you have.

		If **YES**, do your symptoms improve when leaving your neighborhood?		How often do you or anyone else in your household experience these symptoms?		
Cough	□ YES	□ YES	□ NO	□ Daily	□ Weekly	□ Monthly
Wheezing or whistling in chest	□ YES	□ YES	□ NO	□ Daily	□ Weekly	□ Monthly
Tightness in chest	□ YES	□ YES	□ NO	□ Daily	□ Weekly	□ Monthly
Shortness of breath	□ YES	□ YES	□ NO	□ Daily	□ Weekly	□ Monthly
Dizziness	□ YES	□ YES	□ NO	□ Daily	□ Weekly	□ Monthly
Irritation of nose, eyes, or throat	□ YES	□ YES	□ NO	□ Daily	□ Weekly	□ Monthly

15. Do you or anyone in your household experience these health symptoms while at work? If **YES**, please describe your work environment (i.e. office, warehouse, grocery store, etc.?) _____

    _____

    _____

16. Do you or anyone in your household smoke? O Yes O No

    a. If **YES**, do you or anyone else smoke inside of your home? O Yes O No

17. Have you or anyone in your household been diagnosed with any of the following? (Check all that apply)

□ Acute or chronic Bronchitis □ Emphysema

□ Chronic Obstructive Pulmonary Disease (COPD) □ Lung Cancer

□Allergies □Asthma

a. If **YES**, do these symptoms seem better or worse when:

You are inside of your home?	Better	Worse
You are outside at your home?	Better	Worse
You are inside at work or school?	Better	Worse
You are outside at work or school?	Better	Worse

Comments: _____

18. How many times in the last 6 months did you or anyone in your household change your **outdoor** activity levels because you thought the air quality was poor or was affecting how well you felt? Please do not include times when you made changes because of high pollen.

	Spring	Summer	Fall	Winter
1-3 times				
4-6 times				
More than 6 times				

19. Is there anything else that you would like to share with us related to air quality?_____

_____

_____

Thank you for your participation.

Appendix II

PCS Survey (Participant Centered Services Survey)

Providing quality services to you and your family is important to us. Please help us improve your WIC experience. Completing this survey will not affect your WIC benefits or eligibility.

Clinic Experience

1. How welcome do you feel when you walk into your WIC clinic?
   1 2 3 4 5
   Not Welcome Welcome Very Welcome
   If you circled 1 or 2, please explain:
   _____

2. Were you greeted by a staff member? ☐ Yes ☐ No

3. Was the waiting area clean?
   1 2 3 4 5
   Not Clean Somewhat Clean Very Clean
   If you circled 1 or 2, please explain:
   _____

4. On average, do you wait more than 15 minutes after you check in to start your WIC appointment? (Education, certification, re-certification, check pick-up)
   ☐ Yes ☐ No If yes, how long do you wait?_____

5. How has WIC Nutrition Education helped you and your family? Circle all that apply
   a. Increased understanding of health and nutrition including breastfeeding
   b. Increased awareness of community resources (Example: SNAP, Food Banks, Pediatric Dentist)
   c. Helped make healthy changes in behavior (Example: Eat more fruits and vegetables, be more active, quit smoking)
   d. Other: _____

6. Is the time spent discussing nutrition and health related topics: Circle one
   a. Too long b. Too short c. Just right

7. What type of nutrition education do you prefer? Please rank your preference 1, 2, 3, 4, 5
   1—Most Important and 5—Least important
   One on one_____ Pamphlets _____ Videos _____ Group Classes _____ Online_____

8. I have had good experiences when scheduling a WIC appointment by phone. (Ex: No long wait/hold times)
   ☐ Yes ☐ No
   If no, please explain: _____

9. Does the WIC staff listen to you/your child's concerns and seem interested in helping you/your child?
   ☐ Always ☐ Usually ☐ Rarely ☐ Never

10. Do you feel comfortable asking the staff questions?
    ☐ Yes ☐ No ☐ I did not ask any questions

Survey continued on back

11. Which of the following are the hardest to bring to your certification appointments? Circle all that apply
    a. Child
    b. Proof of income (Example: Pay Stub, Medicaid Card, SNAP EBT card)
    c. Proof of address (Example: Utility bill,
    d. Proof of ID (Example: WIC folder, Driver's License, Passport)
    e. Other: _____

12. What is your main reason for missing a WIC appointment?
    a. I have not missed a WIC appointment
    b. Schedule changes and being unable to reach the clinic
    c. Forgetting my appointment
    d. Not having a way to the WIC clinic
    e. Illness
    f. Other: _____

13. How do you want to be reminded of your WIC appointment?
    a. Phone call
    b. Text message
    c. E-mail
    d. Standard mail (example: postcard)

Foods and Store Experience

1. Did the clinic staff explain how to use the WIC checks?
   ☐ Yes ☐ No ☐ I already know how to use the WIC checks

2. How easy is to for you to use your WIC checks?
   ☐ Very Easy ☐ Somewhat Easy ☐ Somewhat Hard ☐ Very Hard

3. If using WIC checks is hard, what is it that makes them difficult to use? Circle all that apply.
    a. Checks are not hard to use
    b. There are too many checks
    c. Words are too small
    d. Staff never explained how to use the checks
    e. There are too many words
    f. Too many foods listed on one check
    g. Other: _____

4. As a WIC customer at the grocery store, what challenges do you face? Circle all that apply.
    a. No challenges
    b. Stores not having adequate stock of all items needed
    c. Locating WIC foods in the store
    d. Purchasing WIC foods separate from non-WIC foods
    e. Language Barriers
    f. Store employees not familiar with WIC approved foods
    g. Check out process
    h. Using coupons with WIC purchases
    i. Other: _____

Nebraska WIC is moving towards replacing your checks with an EBT card called eWIC in 2018.
EBT = Electronic Benefits Transfer

Please respond by putting an 'X' in the box.

Do you think eWIC/EBT card will improve your experience:	Yes	No	Unsure
At the grocery store?			
At the WIC clinic?			

Overall what suggestions do you have to improve WIC services?

_____

_____

_____